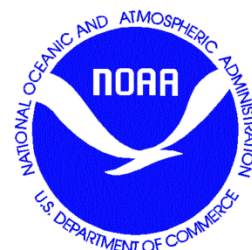


DRAFT 95% DESIGN REPORT
BAYOU DUPONT MARSH AND RIDGE CREATION (BA-48)

PLAQUEMINES/JEFFERSON PARISHES, LOUISIANA

OCTOBER 2010



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RESTORATION DIVISION

LOUISIANA OFFICE OF COASTAL PROTECTION AND RESTORATION

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1.0 INTRODUCTION

The Bayou Dupont Marsh and Ridge Creation project (herein referred to as BA-48) is located in the Barataria Basin approximately 5.5 miles southeast of Lafitte as shown in Figure 1. The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Task Force designated BA-48 as part of the 17th Priority Project List in 2008. The National Marine Fisheries Service (NMFS) was designated as the lead federal sponsor for this project with funding approved through the Coastal Wetlands Planning, Protection, and Restoration Act of 1990 by the United States Congress and the Wetlands Conservation Trust Fund by the State of Louisiana. The Louisiana Office of Coastal Protection and Restoration (OCPR) is serving as the local sponsor with the Restoration Division performing the engineering and design services.

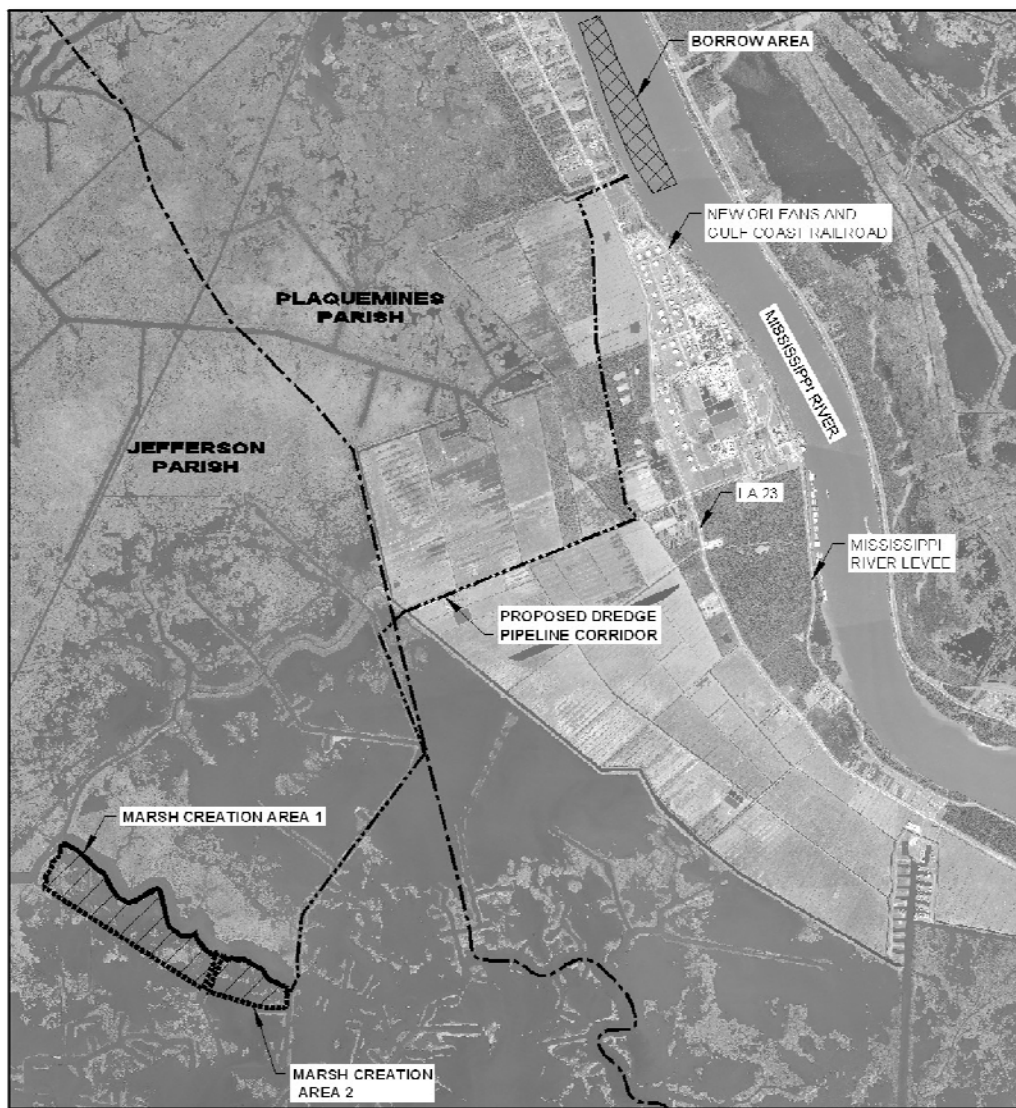


Figure 1 - Proposed Project Area and Features

The objectives of the project are to create approximately 331 acres of sustainable marsh and approximately 11,058 linear feet of restored ridge along the southern shore of Bayou Dupont. This project constitutes using the renewable resource of Mississippi River sediment to create marsh in a rapidly eroding and subsiding section of the Barataria Landbridge and creating a ridge along Bayou Dupont to further sustain this environment. Now converted to mostly open water, the poor condition of this marsh is likely due to a combination of subsidence, dredging of oil and gas canals, and lack of freshwater input. The project area is located near the Mississippi River and is a prime opportunity to utilize the renewable sediment within the river as opposed to hydraulically dredging material from within the Barataria Basin.

Restoration strategies to be used for this project include marsh and ridge creation via sediment delivery pipeline. Healthy marsh will be created by hydraulically dredging sediment from the Mississippi River to fill the open water and broken marsh areas near the Pen and restore the historic shoreline of Bayou Dupont. (See Figure 1.)

Topographic, bathymetric, and magnetometer surveys and a geotechnical investigation have been completed for the marsh fill areas. Bathymetric surveys and geotechnical studies performed in the borrow area have been evaluated. Additionally, a tidal datum analysis has been performed by OCPR to determine the mean water elevations in the fill areas. This information was used to design the project and evaluate the immediate and long-term performance of the newly created project features.

The project team, consisting of members of NMFS and OCPR, performed a kick-off site visit and meeting on April 15th and 17th, 2008, respectively. Based on these meetings, a plan was developed to identify and address all of the project requirements. The engineering and design, environmental compliance, real estate negotiations, operation/maintenance planning, and cultural resources investigations have been completed to the 95% level as required by the CWPBRA Standard Operating Procedures, March 2007.

2.0 TIDES AND WATER LEVELS

Calculations performed during the design of BA-48 include the determination of a tidal datum, or the mean high/mean low water (MHW/MLW) elevations (NAVD 88).

LDNR monitoring gage BA03C-CR-61 was selected to determine historical water levels due to its close proximity to the project area and database availability. This gage is located in Bayou Dupont at 29°37'23.30"N, 90°01'53.18"W. Approximately 3 years of hourly water level data was recorded from November 1, 2000 to December 31, 2003 and used in the tidal datum evaluation.

A standard tidal epoch lasts approximately nineteen (19) years. In order to accurately estimate MHW and MLW, a data set which has less than nineteen (19) years of data should be correlated to a gage which has data from a full tidal epoch using a technique known as the Range-Ratio method. NOAA station #8761724 located at Grand Isle, Louisiana near Barataria Pass at 29°15'48"N, 89°57'24"W was used as the control station for making this correlation. The period of record used for the nineteen (19)

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year tidal epoch is from January 1, 1985 to December 31, 2003. The results of the tidal datum determination for BA-48 are shown in Table 1. A more detailed summary of how this tidal datum was calculated is shown in Section I of the Design Calculation Packet located in Appendix E.

KNOWN VARIABLES	ELEV. FT NAVD 88
MHW _c = 19 YEAR MEAN HIGH WATER AT CONTROL STATION	1.37
MTL _c = 19 YEAR MEAN TIDE LEVEL AT CONTROL STATION	0.85
MLW _c = 19 YEAR MEAN LOW WATER AT CONTROL STATION	0.32
MRC = 19 YEAR MEAN TIDE RANGE AT CONTROL STATION	1.05
TL _c = MEAN TIDE LEVEL FOR THE OBSERVATION PERIOD AT CONTROL STATION	0.99
R _c = MEAN TIDE RANGE FOR THE OBSERVATION PERIOD AT CONTROL STATION	1.06
TL _s = MEAN TIDE LEVEL FOR THE OBSERVATION PERIOD AT SUBORDINATE STATION	0.83
RS = MEAN TIDE RANGE FOR THE OBSERVATION PERIOD AT SUBORDINATE STATION	0.37
CALCULATED VARIABLES	ELEV. FT NAVD 88
MHW _s = 19 YEAR MEAN HIGH WATER AT SUBORDINATE STATION (MHW _s =MTL _s +MR _s /2)	0.87
MTL _s = 19 YEAR MEAN TIDE LEVEL AT SUBORDINATE STATION (MTL _s =TL _s +MTL _c -TL _c)	0.69
MLW _s = 19 YEAR MEAN LOW WATER AT SUBORDINATE STATION (MLW _s =MTL _s -MR _s /2)	0.50
MR _s = 19 YEAR MEAN TIDE RANGE AT SUBORDINATE STATION (MR _s =(MRC*RS)/R _c)	0.37

REFERENCE: Cole, George M. Water Boundaries. New York, NY: John Wiley & Sons, Inc., 1997. pp. 24-27.

Table 1 – Summary of Tidal Datum Determination

3.0 TOPOGRAPHIC AND BATHYMETRIC SURVEYS

In order to facilitate the design of the marsh creation areas, topographic, bathymetric, and magnetometer surveys were performed within each marsh fill area.

Mississippi River bathymetric data performed by the U.S. Army Corps of Engineers (USACE) in 2003 was used to design the proposed borrow area. Bathymetric data obtained by the Louisiana Department of Natural Resources – Coastal Engineering Division in August of 2007 was also evaluated. An example Mississippi River cross section may be found in Appendix B and is shown in Figure 8.

3.1 Secondary Monument

The existing secondary monument "BA23-SM-02" is located on the west bank of Barataria Bay Waterway at Dupre Cut, approximately 3.3 miles south of the Lafitte harbor Marina, and was used to establish control. The coordinates of the monument are N=403,728.62 E=3,680,575.17. The data sheet for monument "BA23-SM-02" is located in Appendix A. Figure 2 shows the location of the monument specified above and the location of additional LDNR survey monuments within the project vicinity.

3.2 Fill Area and Ridge Surveys

Topographic, bathymetric, magnetometer, and average marsh and ridge elevation surveys were performed within and around the proposed marsh creation areas by PBS&J. An RTK GPS unit and an Odom Hydrotrack single beam system using a single frequency transducer and a Trimble DGPS navigation system were used to perform the topographic and bathymetric surveys, respectively. This work was completed in October 2008.

The survey baseline was established south of the proposed marsh creation areas in a northwest - southeast orientation. Twenty-eight (28) survey transects for the topographic survey intersect the baselines at 400 ft. intervals. Elevations were recorded at 25 ft. intervals or less when topographic features that may have an influence on the project were discovered. Seventeen (17) short cross sections were taken at intervals across the existing spoil banks in between and around the two fill areas. Two (2) hydrographic survey lines were taken in Bayou Dupont and the canal between the two marsh creation areas. The survey layout and survey details are shown on the PBS&J survey drawings located in Appendix B.

Nineteen (19) magnetometer lines were surveyed within the BA-48 marsh creation areas. (See layout in Appendix B.) Numerous magnetic anomalies were detected and determined to be insignificant, such as magnetometer noise or storm debris. Four (4) possible abandoned wells were detected. Details of these surveys are shown on the PBS&J survey drawings located in Appendix B.

Average Marsh Elevation Surveys were conducted at four (4) predetermined locations. These surveys consisted of approximately twenty spot elevations at each location utilizing the same equipment used to acquire the elevations in the marsh creation areas. Average marsh elevations for each location were derived by using the following procedure: (sum of elevations at location number divided by the total number of elevations at same location number = Average Elevation). Table 2 shows the data acquired from the four (4) average marsh elevation surveys. The average marsh elevation survey points are shown on the PBS&J survey drawings located in Appendix B. The average marsh elevation of +1.5' NAVD88 was used in the determination of the proposed marsh elevation used for design.

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SPOT ELEVATION NUMBER	ME-1 N=415,014 E=3,690,029	ME-2 N=413,594 E=3,692,883	ME-3 N=410,802 E=3,692,896	ME-4 N=411,295 E=3,696,838
1	1.3	1.4	1.6	1.2
2	1.2	1.2	1.7	1.3
3	2.1	1.6	1.7	1.3
4	1.4	1.4	1.7	1.4
5	1.2	2.1	2.0	1.2
6	1.3	1.4	1.7	1.4
7	1.6	1.5	1.6	1.3
8	1.5	1.8	1.8	1.4
9	1.5	1.5	1.3	1.2
10	1.4	1.6	1.6	1.2
11	1.1	1.6	1.5	1.8
12	1.1	1.4	1.5	1.2
13	1.5	2.0	1.7	1.1
14	1.5	1.7	1.8	1.4
15	1.1	1.6	1.7	1.4
16	1.3	1.8	1.6	1.3
17	1.7	1.8	1.8	1.1
18	1.6	1.8	2.0	1.4
19	1.3	1.8	1.6	1.3
20	1.3	1.5	1.9	1.3
21	1.0	1.5	1.9	1.2
22	1.8	1.6		1.3
23	1.2	1.6		1.3
24		1.7		1.4
25		1.5		1.3
26				1.4
27				1.4
AVERAGE	+1.4	+1.6	+1.7	+1.3
CUMULATIVE AVERAGE = +1.5' NAVD88				

Table 2 - Average Marsh Elevation Survey Results (Locations shown in Appendix B)

Average Ridge Elevation Surveys were conducted at four (4) predetermined locations. These locations consist of existing spoil banks, bayou banks, and high areas near the proposed marsh creation areas. Average ridge elevation surveys were taken in the same manner as average marsh elevation surveys. These locations are shown on the survey drawings in Appendix B. These elevations were used in the determination of the proposed ridge elevation. Elevation shots are listed in Table 3.

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SPOT ELEVATION NUMBER	RE-1 N=414,451 E=3,688,354	RE-2 N=412,850 E=3,691,183	RE-3 N=410,290 E=3,694,308	RE-4 N=409,286 E=3,696,852
1	1.2	1.8	2.7	1.6
2	1.5	1.6	3.5	2.0
3	1.4	1.3	3.5	1.8
4	1.7	1.5	3.1	1.6
5	2.0	1.2	3.6	1.9
6	1.5	1.3	4.0	1.7
7	1.4	1.3	3.7	1.8
8	1.3	1.3	3.4	1.7
9	1.4	1.4	2.7	1.6
10	1.4	1.4	3.1	2.1
11	1.6	1.3	2.6	1.7
12	1.5	1.3	2.8	1.8
13	1.8	0.9	2.9	1.6
14	1.2	1.5	2.4	1.8
15	2.0	1.6	2.8	1.8
16	1.8	1.4	3.0	1.5
17	1.4	1.2	2.8	1.8
18	1.5		3.0	1.9
19	1.4		2.5	2.0
20	1.9		2.5	1.8
21	1.5		3.2	
22	1.6		3.7	
23	2.4		4.1	
24	2.2		3.4	
25			2.7	
AVERAGE	+1.6	+1.4	+3.1	+1.8
CUMULATIVE AVERAGE = +2.0' NAVD88				

Table 3 - Average Ridge Elevation Surveys (Locations shown in Appendix B)

3.3 Borrow Area Surveys

In 2003, the USACE conducted a bathymetric survey of the proposed borrow area. In August 2007, approximately 8.4 line miles of bathymetric, side-scan sonar, chirp sonar sub bottom profiles, and magnetometer surveys were performed in the proposed borrow area by the Louisiana State University Coastal Studies Institute. (See the Results of the Geophysical Survey in Appendix B). The location of the Entergy and Plains pipeline Mississippi River crossings shown in Figure 2 were verified by the 2007 magnetometer survey data.

Currently, the borrow area is being monitored by surveys taken by the USACE New Orleans District on 2-3 week intervals. Based on the latest available date from an August 2010 survey, the borrow area currently holds 2.7 million cubic yards of sediment. Also, as part of the Mississippi River Sediment Delivery System- Bayou Dupont Project (BA-39), a bathymetric survey is scheduled for a 1 year (Spring

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2011) survey evaluation of the dredged borrows area. The intent of the survey is to monitor the sediment infill rate of the recently dredged borrow area for BA-39. Bathymetric and magnetometer surveys will also be performed by the contractor prior to excavation of material for this project.

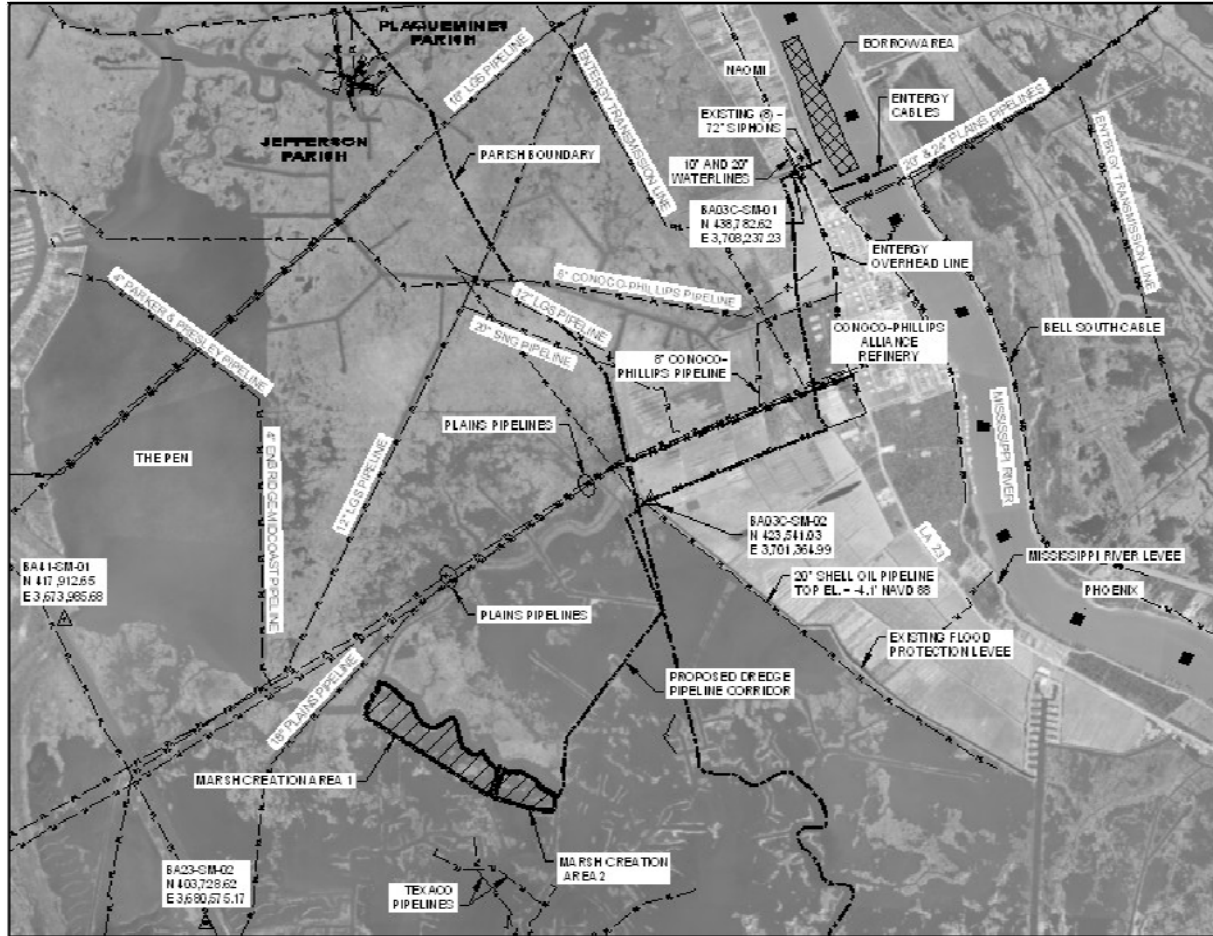


Figure 2 - Existing Survey Monuments and Infrastructure

4.0 GEOTECHNICAL EVALUATION

In order to determine the suitability of the soils in the BA-48 project area for the various proposed marsh creation features, geotechnical subsurface investigation and engineering analyses were performed by URS Corporation, Inc. and completed in July 2009. URS Corporation, Inc. was tasked to collect soil borings and perform laboratory testing to determine soil characteristics and calculate the self-weight consolidation estimates of the marsh fill material as well as consolidation estimates for the underlying soils. URS Corporation, Inc. was also tasked to perform global stability analyses on the containment dikes and calculate the projected underlying settlement of the containment dikes. Settlement analyses were also conducted on the proposed ridge. A detailed summary of the geotechnical subsurface investigation and geotechnical engineering analyses is presented in the geotechnical investigation report prepared by URS Corporation, Inc. shown in Appendix C.

4.1 Borrow Area General Geologic Evaluation

As part of the Mississippi River Sediment Delivery System Bayou Dupont Project (BA-39), three (3) soil borings were drilled in the proposed Mississippi River borrow area to depths of forty (40) feet on May, 2007 (See Figure 3). These three borings taken in the Mississippi River indicate that the borrow area, located on a sand bar, consists of a mixture of sand, silt, and clay, representative of lower Mississippi River channel deposits. Historic borings from the 1980's taken by the USACE prior to excavation of this area also reflect similar sediment. Therefore, it is projected that material with similar characteristics will refill this borrow area used for construction of BA-39. Therefore, soil properties from borings B-1B, B-2B, B-3B were used for the evaluation of the proposed dredged material for the marsh creation in areas 1 and 2. The soil boring logs for B-1B, B-2B, and B-3B may be found in Appendix C.

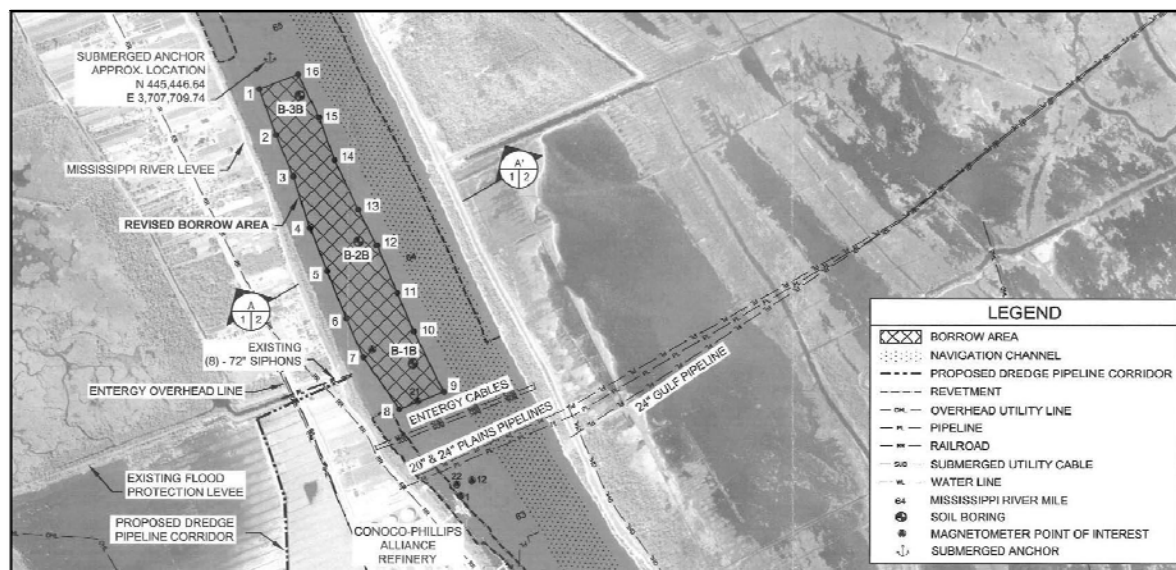


Figure 3 - Revised Mississippi River Borrow Area - Existing Soil Boring Locations

4.2 Geotechnical Subsurface Investigation

Based on past projects and experience in the area, a total of nine (9), three (3) inch, subsurface soil borings were drilled by URS Corporation, Inc. in the marsh creation areas using a marsh buggy mounted rotary drill rig. The marsh area boring locations are shown in Figure 4. The soil boring logs and soil boring coordinates can be found in Appendix C.

Based on proposed project features and geologic formations in this area, soil borings B-1 and B-2 were drilled to a depth of 30 feet, soil borings B-3, B-4, B-7, and B-8 were drilled to a depth of 40 feet, and soil borings B-5, B-6, and B-9 were drilled to a depth of 60 feet.

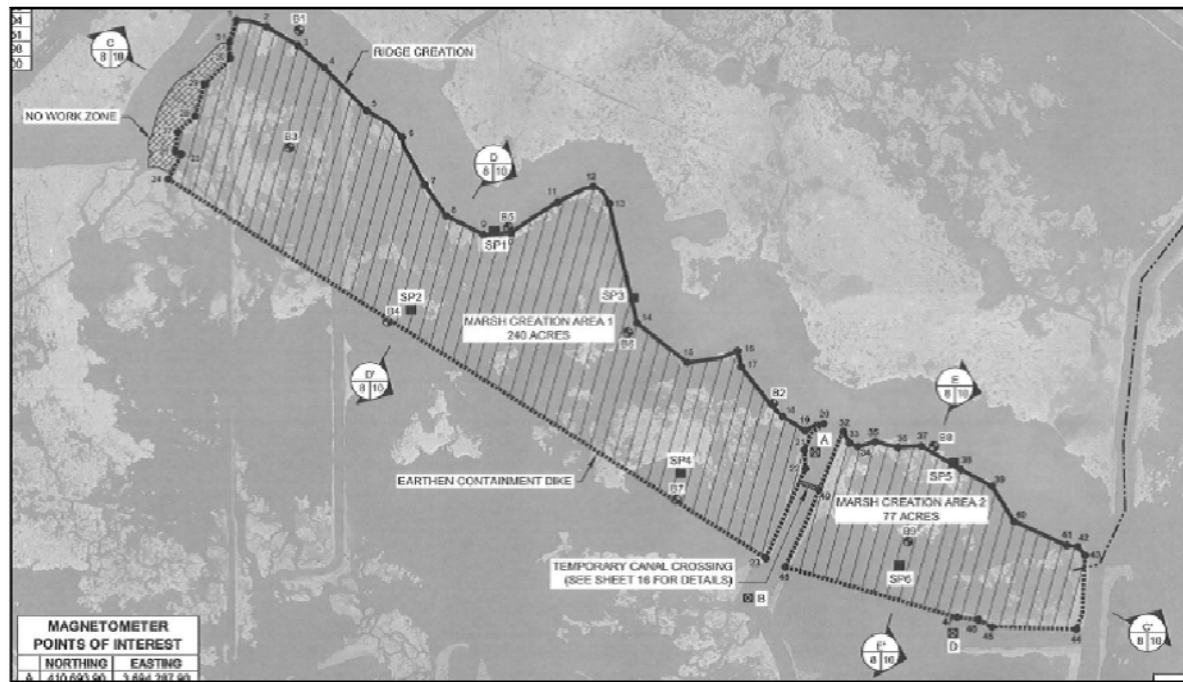


Figure 4 - Marsh Creation Area Layout

4.3 Earthen Containment Dike Global Slope Stability Analysis

The construction of an earthen containment dike using in-situ material is required for the placement of the marsh fill material. Therefore, global slope stability analyses were performed for the earthen containment dikes using the program Slope/W, by Geo-Slope International, Ltd. Circular arcs were divided into vertical slices to delineate the failure planes, and the factor of safety was determined by summing forces and moments. A minimum safety factor of 1.3 was used for analyses.

For the earthen containment dikes, engineering soil properties from soil borings B-1, B-2, B-4, B-5, B-7, and B-8 were evaluated to conduct the global slope stability analyses. The containment dikes were evaluated using heights ranging from 4 to 6 feet with and without marsh fill. A design crown elevation of +4.0 feet NAVD 88 is required to account for one foot of freeboard above the marsh fill at +3.0 feet NAVD 88. Based on several analyses, it was determined that a crown width of six (6) feet and side slopes of 1(V):4(H) were required to construct a stable earthen containment dike. Therefore, a target crown elevation of +4.0' NAVD88 with a crown width of six (6) feet and side slopes of 1(V):4(H) were used for the earthen containment dike design. The earthen containment dike will be constructed in several lifts using a marsh buggy hoe using a minimum berm distance of 25 feet.

4.4 Estimated Settlement Analyses

One Dimensional consolidation theories were applied to estimate the total settlement for the earthen containment dikes and marsh fill. The 1-D Terzaghi geotechnical engineering consolidation theory was used to evaluate both the rate and magnitude of consolidation for the settlement of the earthen containment dike. Long term consolidation evaluations for the hydraulically dredged fill material were conducted using the **Primary consolidation, Secondary compression and Desiccation of Dredged Fill (PSDDF)** software developed by the USACE. The PSDDF results were also compared to the hand calculations using finite-strain geotechnical consolidation theory to determine recommended values.

4.4a Earthen Containment Dike Settlement Analysis

Settlement calculations for the earthen containment dikes were based on the soil parameters obtained from consolidation tests. (See Appendix C for boring logs). An earthen containment dike settlement analysis is composed of two (2) parts: (1) the settlement in the underlying soils due the weight and pressure of the earthen containment dike, and (2) the settlement within the containment dike itself due to self-weight consolidation using in-situ soils. A crown width of 6.0 ft. and a 1(V):4(H) side slope was used based on the results of the slope stability analysis (See Figure 5). A calculated mean low water depth of +0.5 feet, was used throughout the project area and a dike crown elevation of +4.0 ft. was evaluated. In general, the total estimated settlement over twenty (20) years of the containment dikes in the project area was estimated to be approximately 2.0 feet, with 0.75 to 1.25 feet occurring in the first one to two years. Based on the construction of similar projects in the area, it is anticipated that the dikes will be constructed in several lifts and are critical during the few months after placement. With the target marsh elevation for the project area being approximately +1.5' NAVD 88, it is concluded that containment dikes built in the project area to an elevation of +4.0' NAVD 88 would not settle to marsh elevation over the project design life of 20 years. However, due to the trend of opening marsh areas south of the proposed project area, it is anticipated that exposed earthen containment dikes will possibly degrade due to increased exposure to wave action. The earthen containment dikes will need to be gapped and should be degraded in preferred areas upon completion of project construction to achieve a healthy marsh platform.

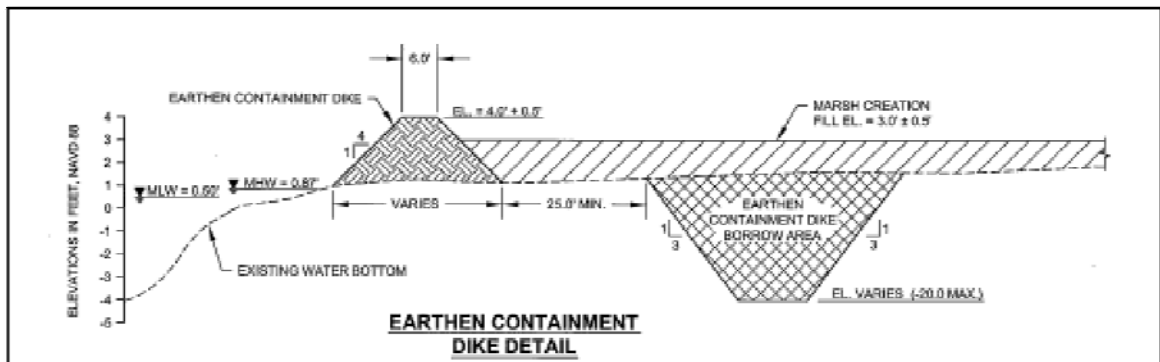


Figure 5 - Earthen Containment Dike Typical Section

4.4b Marsh Fill Settlement Analysis

In addition to traditional hand calculations, URS Corporation evaluated the marsh settlement using the USACE model Primary Consolidation, Secondary Compression, and Desiccation of Dredged Fill (PSDDF). Geotechnical parameters were entered into the program and settlement calculations over twenty years were generated. The input data for the PSDDF model are the results produced by the self-weight consolidation test including specific gravity, void ratios, effective stress values, primary and secondary consolidation parameters, and permeability values. Input parameters for the foundation soils include specific gravities, void ratios, effective stress values, primary and secondary consolidation parameters, and permeability values from several soil layers in approximately the top twenty feet of the foundation. The results of the model runs were similar in magnitude to the settlement hand calculations.

4.4c Recommended Marsh Fill Elevation

The OCPR evaluated the results of the geotechnical investigation and the data used to develop settlement curves for the proposed marsh fill. Based on the estimated settlement analyses performed by URS Corporation, Inc., the OCPR and NMFS recommends using a constructed marsh fill elevation of +3.0' NAVD88. The intertidal zone in this area is approximately between 0.5 feet NAVD88 and 0.9 feet NAVD88. Figure 6 indicates the total settlement over time for the hydraulically dredged marsh fill material.

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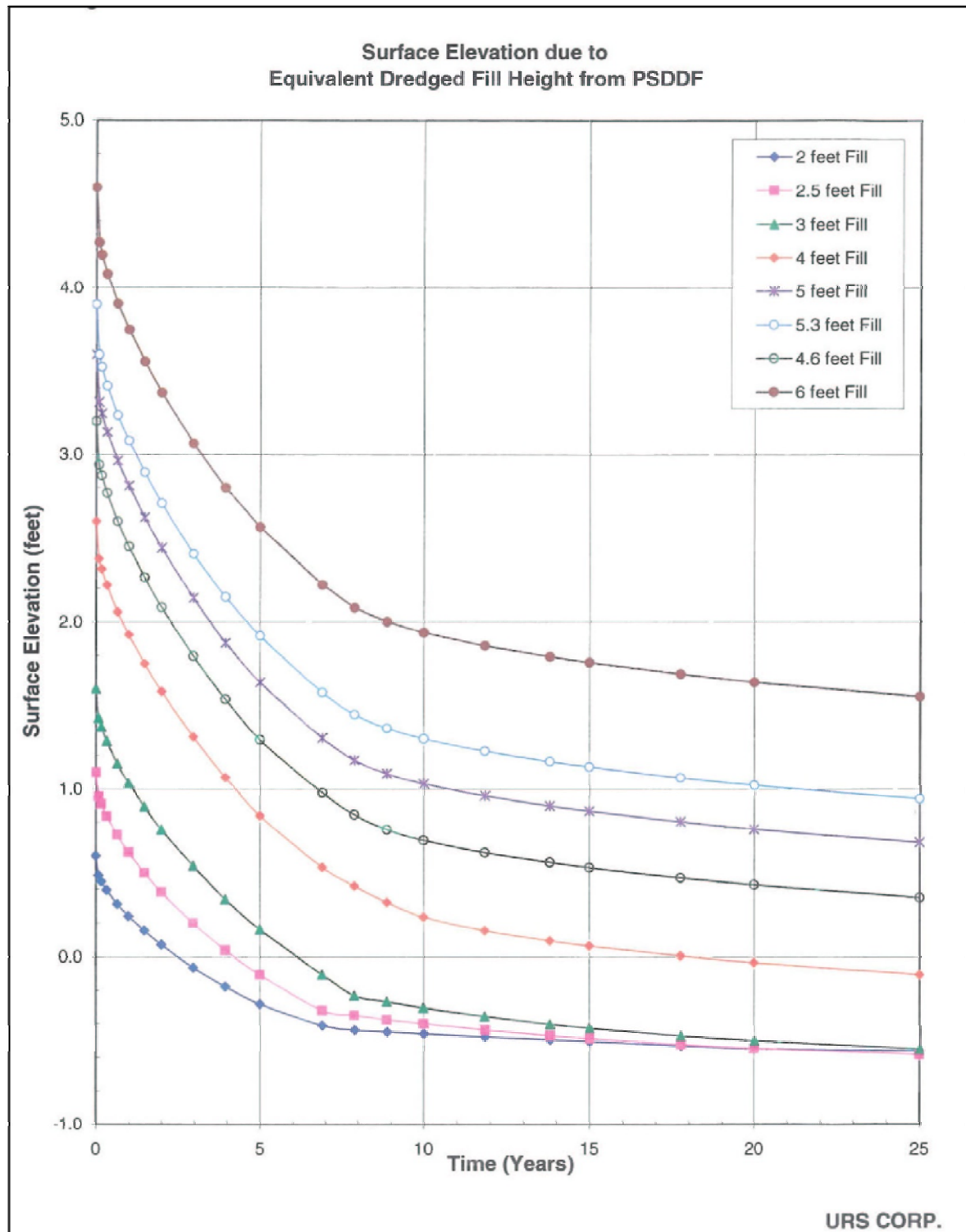


Figure 6 - Marsh Fill Estimated Total Settlement Curves

4.5 Borrow to Fill Ratio Recommendations

The borrow to fill ratio for the hydraulically dredged material from the Mississippi River was estimated based on experience from past dredging projects. Sandy sediments tend to require lower borrow to fill ratios, for moisture contents less than 40%, at approximately 1.25:1 to 1.5:1. Borrow to fill ratios for silts and clays are typically between 2:1 for moisture contents between 40% and 60% and 3:1 for moisture contents greater than 60%. These estimates exclude shrinkage and discarding unsuitable organic materials. Considering these figures and in-situ soil conditions, the OCPR has selected a borrow to fill ratio of 1.5:1 for the marsh fill material to account for dredging losses.

The borrow to fill ratio for mechanical dredging was primarily based on the expected transport losses during construction and water loss shrinkage of the clayey material in the project area. Based on these factors and past construction experience, a borrow to fill ratio of 2.5:1 was used for design.

5.0 BORROW AREA EVALUATION

The controlling factors of this design component include the Mississippi River borrow area delineation and the borrow area volume. The size of the borrow area is also governed by the volume of material calculated to fill the marsh creation areas as discussed in Section 5.2. The borrow area must also contain sufficient sediment for the marsh fill requirements in a relatively small, accessible area.

5.1 Borrow Area Delineation

5.1a USACE Mississippi River Dredging Guidelines

The following is a list of USACE physical borrow area guidelines and restrictions:

- All excavations must be made at least 750 feet from any levee centerline.
- Borrow areas must be outside the USACE maintained navigation channel.
- Excavation in the river must not be made less than 4,000 feet upstream of a bridge crossing.
- The side slopes of the borrow area must be no steeper than 1(V):5(H).
- The excavation must proceed from landside to riverside limits to minimize the possibility of overburden failure of the bank.

The eastern boundary of the borrow area is delineated by the navigation channel. The western boundary of the borrow area is delineated by a minimum 750 foot offset from the centerline of the levee. This boundary exists to ensure that a 1.3 factor of safety remains for the slope stability of the river levee. If the elevation of the landside of the river levee is greater than the elevation of the river side, the elevation of the land side must be projected towards the river to intersect the 750' offset line. At this intersection, side slopes of 1(V):5(H) are projected toward the river to the intersection of the mud line. Dredging may only take place from this point. Along most of the borrow area, this is the case. At some points, the elevation of the landside is less than the elevation of the river side, for which the centerline of the levee was projected 750' toward the water to delineate the western boundary of the borrow area. For a cross-sectional

diagram of this USACE regulation, please see Figure 7. LIDAR data was used to determine the landside elevations near the river levee, and these were used to delineate the western boundary of the borrow area.

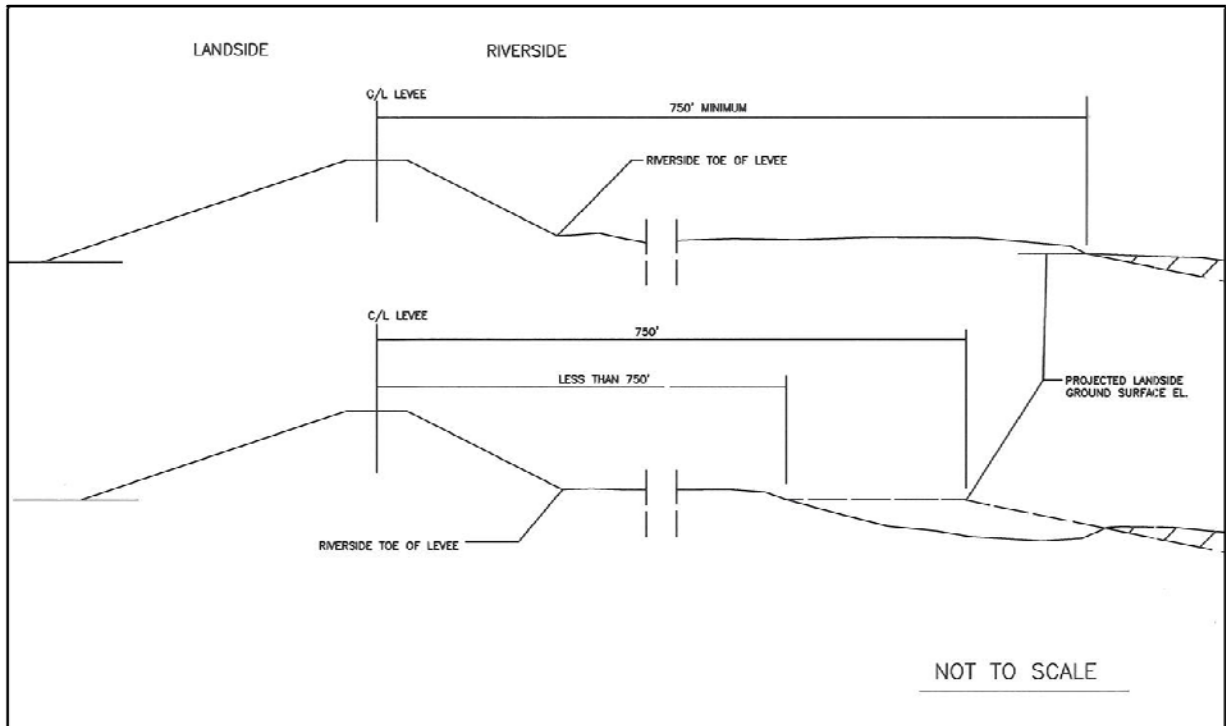


Figure 7 - Mississippi River Dredging Guidelines and Restrictions

5.1b Pipelines and Utilities

A submerged transmission line owned by Entergy is located south of the proposed borrow area. Entergy has provided surveys to OCPR to prevent the disturbance of the line. The southern boundary of the proposed borrow area has been delineated 500 feet upstream of the line. The OCPR has collected as much information as possible regarding known pipelines and utilities in the project area and borrow area as shown on Figures 2 and 9. However, the contractor will be required to perform a magnetometer survey of the Marsh Creation Areas and the Borrow Area prior to excavation.

5.1c Proposed Borrow Area

Sufficient sediment was located nearest to the marsh creation areas in the proposed borrow area, located between River Miles 63.5 and 65.0. This borrow area is located north of Alliance Refinery, so barge traffic and refinery operations should not be impaired. It is adjacent to the Naomi siphon, which is owned by Plaquemines parish. The borrow area footprint is restricted immediately downstream by pipelines, revetment, and inaccessible depths. The borrow area footprint is restricted upstream by depth.

Hydrographic surveys of the Mississippi River performed in 1992, 2003, and 2007 were used to designate the borrow area. The bathymetry of the Mississippi River channel changes continuously due to seasonal flows and sediment transport. However, an evaluation of the survey data

specified above determined no significant volume change between surveys. The proposed borrow area is located on an expanding sand bar that has been mined and used previously by the USACE and the OCPR. It has recently been dredged to create marsh as part of the Mississippi River Sediment Delivery System – Bayou Dupont (BA-39) project, which was constructed by the Great Lakes Dredge and Dock Company in 2009-2010. Post-construction monitoring surveys have been and will continue to be performed to estimate an average refill rate. As per construction specification requirements, hydrographic surveys of the borrow area will be taken prior to construction of BA-48. However, since this area has been excavated and refilled in the past, it is expected that a sufficient quantity of material will be present at the time of construction (Fall 2011).

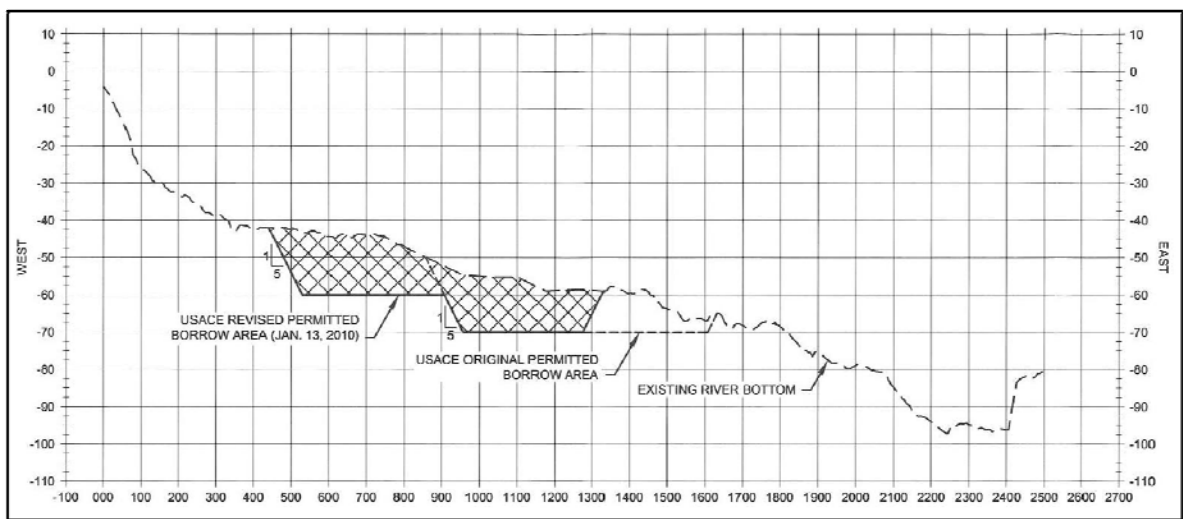


Figure 8 - Revised Mississippi River Borrow Area Template

5.2 Borrow Area Volume and Design

The required borrow volume is computed by multiplying the fill volume by the borrow to fill ratio of 1.5 for hydraulically dredged material as mentioned in Section 4.5. A conventional cutter head dredge can cut to a maximum of approximately 70 feet below the water surface. Historical water surface elevation data in the Mississippi River at Alliance shows that the water elevation in the summer and fall typically fluctuates between +3' and +4' NAVD88. Since this is the highest river stage in this area outside of extreme high water events when dredging is prohibited by the USACE, the maximum depth of cut was assumed to be -66' NAVD88 to account for the water level elevation of +4' NAVD88. The borrow volume was maximized to account for any unforeseen issues that may arise. The total volume of available sediment in the proposed borrow area is approximately 4,066,800 cubic yards based on the historical 2003 hydrographic survey. As previously mentioned, the latest survey date indicates the borrow area currently holds around 2.7 million cubic yards of sediment. A total marsh fill volume of 3,219,300 cubic yards is required to fill areas 1 and 2, (including refilling containment dike and ridge borrow areas). Details on the borrow site design are shown in Section IV of the Design Calculations Packet located in Appendix E.



Figure 9 - Revised Mississippi River Borrow Area

The proposed Mississippi River borrow area is shown above in Figure 9. The design meets all USACE dredging requirements, contains sufficient borrow volume, and avoids obstructions and interruption to navigation.

6.0 MARSH CREATION DESIGN

The project objective is to create marsh by pumping sediment from the Mississippi River into the designated marsh fill areas shown in Figure 4. The marsh creation design was broken into four (4) components: the marsh creation fill areas, containment dikes, ridge creation and the dredge borrow area. The design and analysis of each component is discussed in the sections below.

6.1 Marsh Creation Fill Area Delineation

Marsh Creation Area 1 encompasses approximately 249 acres in water depths ranging from 1-2 feet. This area is bounded by Bayou Dupont to the northeast and southwest and an existing spoil bank to the southeast. Marsh Creation Area 2 encompasses approximately 82 acres. The northeastern and southwestern boundaries of this site are bounded by existing spoil banks, with Bayou Dupont serving as the northeastern boundary. Minimal containment will be built along the existing spoil banks, which will provide a favorable foundation upon which to build earthen dikes. Full containment will be built along the southwestern boundary of both marsh creation areas. Approximately 15,120 linear feet of containment dike and 11,060 linear feet of ridge will be required between the two marsh creation areas.

In an effort to avoid a cultural resources site, the area between the northwestern side of the project area and Bayou Dupont has been designated a no work zone. This no work zone was suggested and approved by the Louisiana State Historic Preservation Office. This no work zone can be seen in Figure 4.

6.2 Marsh Fill Area Design

6.2a Marsh Fill Target Elevation

The main marsh creation design component of BA-48 involves the calculation of the fill area volumes. Before this could be accomplished, a target marsh fill elevation had to be determined. This elevation was governed by several factors including average healthy marsh elevation, the tidal datum, the physical properties of the borrow material, and the estimated settlement of the underlying soils.

The first step of the fill elevation design involved an examination of the existing marsh conditions. The average marsh elevation survey performed during the fill area survey revealed that the average marsh elevation of healthy marsh near the project area was approximately +1.5' NAVD 88 (see Section 3.2 for additional details). The calculated tidal datum (MHW=0.87' NAVD 88, MLW=0.50' NAVD 88) shown in Section 2.0 verified that the existing marsh predominantly fell above the project inter-tidal zone, the range of elevations that lie in between the upper and lower extents of the tidal datum. In order to evaluate the performance of the created marsh over the 20 year life of the project (standard for CWPPRA), the project team decided that the criteria would be marsh elevation. To achieve a sustainable marsh elevation throughout the life of the project, the marsh platform will initially have to be pumped to an elevation higher than MHW during construction and settle into the inter-tidal zone over time. Considering the unfavorable constructability of pumped marsh fill, pumping to elevation +3.0 ft. will yield a marsh elevation as close as possible to +1.3' NAVD 88 at approximately target year five. Based on physical observations of LDNR ecologists and field biologists, this will meet healthy marsh requirements. At the end of the project's 20 year life, the marsh elevation is projected to be in the intertidal zone. In addition, the previously constructed LDNR Bayou Dupont Dedicated Dredging project, approximately 3.8 miles to the west near the south shore of the Pen, was surveyed at elevation +1.34' NAVD88 in March of 2007. Upon visual inspection, this area is exceptionally healthy. Using this elevation, the marsh will be inundated approximately 25% of the time after initial settlement. Considering the dominant species of vegetation in the area, *spartina patens*, this level of flooding should be ideal (Lindquist 7). Filling below this elevation will result in an elevation below the intertidal range at the end of the 20 years.

In order to determine the construction fill elevation, LDNR tasked URS Corporation, Inc. to run consolidation settlement calculations for borings B-1 through B-9 taken in marsh creation areas 1 and 2. Additionally, self-weight consolidation tests were run using a composite sample from Borings B-1B, B-2B, and B-3B, which are located in the borrow area. Fill elevations of +0.5', +1.0', +1.5', +2.5', +3.5', and +4.5' were evaluated for the consolidation calculations. The purpose of these analyses was to assist in the determination of a construction fill elevation that

would be as close as possible to the existing marsh elevation after 20 years, and that would fall within the desired zone for the longest period of time possible. After reviewing the data, the project team concluded that the majority of the settlement would be complete five (5) years after construction. However, the marsh will continue to settle throughout the twenty year project life. It was also concluded that a target marsh fill elevation of +3.0' NAVD 88 would ultimately settle to an elevation within the intertidal zone. These settlement values are composed of foundation settlement and self-weight consolidation settlement. At a constructed elevation of +3.0' NAVD 88, the marsh will quickly settle to a healthy elevation and remain above or within the intertidal zone for the project life.

6.2b Marsh Fill Volumes

Once the target marsh fill elevation was determined, the marsh fill volumes were calculated. Cross-sectional areas of the transects in each fill area were calculated using the data produced by the Fill Area Survey described in Section 3.2. Marsh fill area volumes were then computed using these areas. Table 4 shows the results of the volume calculations for each marsh fill area. A more detailed summary of the marsh fill area design is shown in Section II of the Design Calculation Packet located in Appendix E.

MARSH FILL AREA	AREA (acres)	MARSH FILL VOLUME AT +3.0 (yd ³)	HYDRAULICALLY DREDGED VOLUME REQUIRED (yd ³)*
AREA 1	249	1,295,101	1,942,652
AREA 2	82	451,869	677,804
Totals	331	1,746,970	2,620,455

Table 4 - Summary of Marsh Fill Area Volumes

*Determined using a fill elevation of +3.0' NAVD 88 and a Borrow to Fill Ratio of 1.5:1

6.3 Containment Dike Design

The primary design parameters associated with the containment dike design include crown elevation, crown width, and side slopes. The OCPD tasked URS Corporation, Inc. to determine these parameters for slope stability and settlement analyses. URS Corporation, Inc. recommended that containment dikes built to a +4.0' NAVD 88 crown elevation with a 6 ft. crown width and 1(V):4(H) side slopes would not result in slope failures. The containment dikes shall be constructed using in-situ material from within each fill area which will be refilled with hydraulically dredged material. For stability purposes, URS recommended that the dike borrow pits be located at least 25 ft. from the toe of the dike and that borrow areas are excavated to no more than -20' NAVD 88. Once these parameters were determined, cross-sectional areas and containment volumes were calculated using AutoCAD. Table 5 summarizes the containment dike volume calculations. The total in-situ borrow volume that will be refilled by hydraulically dredged material is calculated to be 140,218 cubic yards. Applying the borrow to fill ratio for hydraulic dredging of 1.5:1 produces a total volume 210,327 cubic yards that will be hydraulically dredged to refill the earthen containment dike borrow pit.

EARTHEN CONTAINMENT DIKE	DIKE LENGTH (ft)	CALCULATED VOLUME (yd³)
Area 1 - CD	10,082	37,401
Area 2 - CD	5,038	18,686
Total (in place)	15,120	56,087
Total (borrow) (2.5:1 cut:fill)		140,218

**Table 5 – Earthen Containment Dike Quantities
(Mechanically Dredged Material)**

6.4 Ridge Creation Design –Alternatives Evaluation

6.4a Ridge Core Design

Based on the soil properties of the Mississippi River material and the in-situ project area material, the design team recommends that the ridge core be constructed out of the insitu material. This will provide containment for the marsh fill areas and will ensure the longevity of the ridge feature. The primary design parameters associated with the ridge core design include the ridge constructability, the construction equipment access, and the ridge geometrical parameters.

6.4b Ridge Constructability

URS Corporation, Inc. was tasked with evaluating the material within Bayou Dupont to be used for the construction of the ridge core. Soil borings taken in Bayou Dupont indicate very soft organic soils within the top 10 to 20 feet in depth. Due to the water depth in Bayou Dupont, a small mechanical bucket dredge would be required to excavate material within the bayou and place it for the ridge core. The removal or excavation of the soft material within the bayou would be difficult to recover material in the bucket for placement. Excavation near the ridge could impact the stability of the newly constructed ridge and result in a slope failure. Based on these criteria, the design team recommends that the borrow material be taken from the interior of the marsh fill area, thus minimizing the stability of the ridge during construction.

6.4c Construction Equipment Access

The design team also evaluated the construction equipment access to the project site based on past projects and the type of equipment required to construct the proposed project features. The use of a mechanical bucket dredge will require a barge draft of approximately 6 to 7 feet and would require access from the Barataria Waterway, then into the Pen, and along the remnants of Bayou Dupont. This would require the removal and replacement of the weir near Barataria Waterway and partial dredging along the remnant Bayou Dupont, thus adding cost and time to the proposed project.

The design team also evaluated the use of marsh buggy hoe equipment for the construction of the ridge core. This equipment is capable of operating in a maximum depth of 2 to 4 feet and has a maximum reach of approximately 45 to 60 feet. The proposed interior borrow will require

the use of several marsh buggy excavators to remove and place the material required for the ridge core. The marsh buggy is capable of traveling along the proposed access route to the project area and will not require excavation of material for access. Therefore, based on the stability of the newly constructed ridge core and the construction equipment logistics, marsh buggy excavators have been chosen to construct the ridge. This equipment will also be used to construct the earthen containment dikes.

6.4d Ridge Geometrical Parameters

URS Corporation, Inc. recommended that a ridge core built to a +4.5' NAVD 88 crown elevation with a 30 ft. crown width and 1(V):4(H) side slopes would not result in slope failures. The ridge core shall be constructed using in-situ material from within each fill area which will be refilled with hydraulically dredged material. For stability purposes, URS Corporation, Inc. recommended that the dike borrow pits be located at least 25 ft. from the toe of the dike and that borrow areas are excavated to no more than -20' NAVD 88. See Figure 10 below.

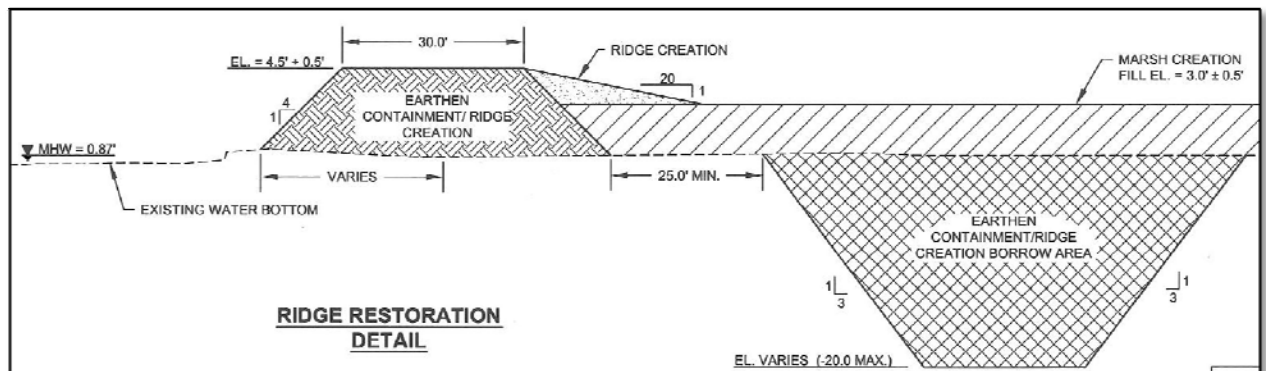


Figure 10 - Ridge Typical Section

Once these parameters were determined, cross-sectional areas and ridge core volumes were calculated using AutoCAD. Table 6 summarizes the ridge core volume calculations. The total in-situ borrow volume that will be refilled by hydraulically dredged material is calculated to be 251,638 cubic yards. Applying the borrow to fill ratio for hydraulic dredging of 1.5:1 produces a total volume 377,457 cubic yards that will be hydraulically dredged to refill the ridge borrow pit.

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RIDGE CORE	CORE LENGTH (ft)	CALCULATED VOLUME (yd ³)
Area 1 - RC	8,266	75,447
Area 2 - RC	2,792	25,208
Total (in place)	11,058	100,655
Total (borrow) (2.5:1 cut:fill)		251,638

**Table 6 - Ridge Core Quantities
(Mechanically Dredged Material)**

6.4e Ridge Wedge Design

In order to transition from the ridge to the marsh fill, a ridge wedge, as seen in Figure 10, shall be hydraulically constructed with a 1(V):20(H) slope running from the top of the ridge core to the marsh fill area. This wedge shall run the entire length of the ridge. The volume for the wedge was calculated using a cross sectional area of 18ft²/lin. ft. of ridge. The volumes are shown below in Table 7. A more detailed summary of the ridge wedge design is shown in Section V of the Design Calculation Packet located in Appendix E.

MARSH FILL AREA	RIDGE WEDGE LENGTH (ft)	RIDGE WEDGE VOLUME (yd ³)	HYDRAULICALLY DREDGED VOLUME REQUIRED (yd ³)*
AREA 1	8,266	5,511	8,267
AREA 2	2,792	1,861	2,792
Totals	11,058	7,372	11,058

Table 7 - Summary of Ridge Wedge Volumes

*Determined using a slope of 1V:20H and a Borrow to Fill Ratio of 1.5:1

6.5 Total Volume Calculations

All volumes calculated and shown in this design report are to the maximum tolerances as specified in the plans. Adding the ridge wedge volume (7,372 cubic yards) to the volume required to fill the marsh fill areas (1,746,970 cubic yards), the volume required to refill the containment dike borrow pit (140,218 cubic yards), and the volume required to refill the ridge core borrow pit (251,638 cubic yards) yields a total volume of 2,146,200 cubic yards for the marsh fill. Multiplying this by the hydraulically dredged cut to fill ratio 1.5:1 yields a total hydraulically dredged volume of 3,219,300 cubic yards.

7.0 CONSTRUCTION COST ESTIMATE

The construction cost estimate will be available in hard copy form at the 95% Design Review Presentation on October 27, 2010.

8.0 MODIFICATIONS TO APPROVED PHASE 0 PROJECT

As a result of Phase 1 activities, the approved Phase 0 project has undergone project area modifications. The project goals now involve the construction of 289 acres of brackish marsh versus the originally proposed 287 acres of combined marsh creation and nourishment. The overall project area has been slightly reduced due to a 13-acre cultural resources buffer area in the northwest extreme of the project area. The target marsh elevation has decreased from +1.43' NAVD 88 to +1.3' NAVD 88 as a result of average marsh elevation surveys. The profile of the proposed ridge has changed as well. Originally the ridge was to be constructed to an elevation of +4' NAVD 88 with a crown width of 125' and 1(V):6(H) side slopes. A maintenance event was originally planned for TY3 that involved a second lift on the ridge bringing it up to +6' NAVD 88. The ridge design was updated to the section shown in this report. The new proposed design is a +4.5' NAVD 88 elevation with a 30' crown width and 1(V):4(H) side slopes on the bayou side with 1(V):20(H) side slopes on the inland side down to marsh elevation. Currently, no plans exist in the design of this project for a maintenance event. There has been a substantial increase in estimated construction costs based on recalculation of mobilization/demobilization and unit costs for dredging from the river based on distance to the fill site. Those changes can be found in the fully funded cost estimate.

10.0 REFERENCES

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